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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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10/080,468

02/22/2002

Hua Ji

M-12589 US

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7590

06/25/2004

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EXAMINER

MAI, ANH D

ART UNIT

PAPER NUMBER

2814

DATE MAILED: 06/25/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

**Office Action Summary**

Application No.

10/080,468

Applicant(s)

Ji, HUA

Examiner

Anh D. Mai

Art Unit

2814

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 14 June 2004.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-4, 6-10, 12, 13, 15-26, 28 and 30-34 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-4, 6-10, 12, 13, 15-26, 28 and 30-34 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)  
Paper No(s)/Mail Date \_\_\_\_\_
- 4) ☐ Interview Summary (PTO-413)  
Paper No(s)/Mail Date. \_\_\_\_\_
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: \_\_\_\_\_

## DETAILED ACTION

### *Status of the Claims*

1. Amendment filed June 14, 2004 has been entered. Claims 19, 31 and 32 have been amended (claims 31 and 32 have been previously added after the Final Rejection dated 1/12/04). Claims 33 and 34 have been newly added. Claims 1-4, 6-10, 12, 13, 15-26, 28 and 30-34 are pending.

### *Claim Rejections - 35 USC § 112*

The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

2. Claims 31-34 are rejected under 35 U.S.C. 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention.

The claims 31-34 recite an etch-to-deposition (E/D) ratio between about 0.0 and about -0.05.

The specification described:  $E/D = (UBUC - BUC)/UBUC$

Where UBUC is deposition rate with no bias; and **BUC** is deposition rate with bias.

It is well known that, in deposition without bias, no etching component is present and deposit with bias, there is an etching component involve. Therefore, under a same parameters the deposition rate of without bias (UBUC), e.g., no etch, is **always** larger than with bias (BUC), e.g., having material removed.

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The negative E/D means  $BUC > UBUC$ .

**How can BUC be large than UBUC while there is an etching component involved ?**

In a another term, E is etching to remove material. This value always positive. D is depositing to add material. This value also positive.

Therefore, E/D is always positive.

3. Claims 1-4, 6-10, 12, 13, 15-26, 28 and 30-34 are rejected under 35 U.S.C. 112, first paragraph, because the best mode contemplated by the inventor has not been disclosed. Evidence of concealment of the best mode is based upon Applicant admission in the Chen Declaration.

Applicant admitted that: “the deposition rate with bias (BUC) may be larger than the deposition rate without bias (UBUC) **in some regimes**”.

However, these “regimes” have never been made public, neither in the Declaration nor in the specification.

**What are those regimes that BUC are larger than UBUC ?**

The ordinary skill in the art needs to know, since undue experimentation seem to be unavoidable.

Public policy requires the Applicant in exchange for a Patent, all aspect of the invention must be disclosed, including the best mode.

### ***Claim Rejections - 35 USC § 102***

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

4. Claims 1-4, 6-10, 12, 15-26, 28 and 31-34 are rejected under 35 U.S.C. 102(e) as anticipated by Van Cleemput et al. (U.S. Patent No. 6,395,150).

With respect to claim 1, Van Cleemput teaches method for filling a gap during integrated circuit fabrication as claimed including:

providing a gas mixture comprised of silicon-containing and oxygen-containing components, wherein the oxygen-containing component is no more than 21% total concentration by volume of the gas mixture; and

performing an HDP-CVD process using the gas mixture to fill the gap (510) with a dielectric (525) having a selected refractive index, wherein the ratio of the oxygen-containing component to the silicon-containing component is below about 1.2 to form the dielectric having a selected refractive index and to fill the gap without cusp formation. (See Figs. 5A-D).

The dielectric material (525) of Van Cleemput is SiO<sub>2</sub>, thus, has a selected refractive index.

With respect to “the oxygen-containing component is no more than 21% total concentration by volume of the gas mixture”, the mole fraction of He (an inert component) is used in the mixture in the range of 15%-90%, thus, the claimed range oxygen-containing component of no more than 21% total concentration is fall within the remaining of the gas mixture. (See col. 3, ll. 40-45).

With respect to the ratio of the oxygen-containing component to the silicon-containing component is below about 1.2, the claimed ratio of 1.2 fall within the teaching value of Van Cleemput. (See Table 1).

With respect to claim **19**, Van Cleemput teaches method for filling a gap during integrated circuit fabrication as claimed including:

providing a gas mixture comprised of silicon-containing and oxygen-containing components, wherein the oxygen-containing component is no more than 21% total concentration by volume of the gas mixture; and

filling the gap (510) without cusp formation by using the gas mixture for simultaneous high density plasma chemical vapor deposition and sputter etching (HDP-CVD). (See Figs. 5A-D).

With respect to the “no more than 21% total concentration”, similar reasoning as that of claim 1 also applies here.

With respect to claim **30**, Van Cleemput teaches method for filling a gap during integrated circuit fabrication as claimed including:

providing a gas mixture comprised of oxygen-containing and silicon-containing components, wherein the gas mixture has a ratio of oxygen-containing component to silicon-containing component below about 21% total concentration by volume of the gas mixture; and

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filling the gap (510) without cusp formation by using the gas mixture for simultaneous high density plasma chemical vapor deposition and sputter etching (HDP-CVD). (See Figs. 5A-D).

With respect to the “below about 21% total concentration”, similar reasoning as that of claim 1 also applies here.

With respect to claim 34, as best understood by the examiner, Van Cleemput teaches method for filling a gap during integrated circuit fabrication as claimed including:

providing a gas mixture comprised of silicon-containing and oxygen-containing components, wherein the gas mixture has a ratio of oxygen-containing component to silicon-containing component below about 1.3; and

filling the gap (510) without cusp formation by using the gas mixture for simultaneous high density plasma chemical vapor deposition and sputter etching (HDP-CVD), wherein gap (510) is filled at an etch-to-deposition ratio. (See Figs. 5A-D).

With respect to the ratio of oxygen-containing component to silicon-containing component, see Table 1.

With respect to claim 2, the silicon-containing components of Van Cleemput includes a concentration (no more than 18%) by volume of the gas mixture as claimed.

With respect to claims 3, 6, 20 and 22, the silicon-containing and oxygen-containing components of Van Cleemput have the flow rates that include claimed range.

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With respect to claims 4 and 21, the silicon-containing component of Van Cleemput comprises silane.

With respect to claims 7 and 23, the oxygen-containing component of Van Cleemput comprises a O<sub>2</sub>.

With respect to claims 8, 10, 24 and 26, the gas mixture of Van Cleemput is further includes an inert component, He.

With respect to claims 9 and 25, the inert component of Van Cleemput has a flow rate (10-2000 sccm) that includes the claimed range (305-358 sccm).

With respect to claims 12 and 28, the ratio of oxygen-containing component to silicon-containing component of Van Cleemput includes the claimed ranges. (See Table 1).

With respect to claim 15, the dielectric (525) of Van Cleemput comprises silicon oxide.

With respect to claim 16, the dielectric (525) of Van Cleemput is SiO<sub>2</sub> thus, inherently having a refractive index of 1.46.

With respect to claim 17, the process of Van Cleemput further comprises: providing a low frequency (LF) power source operable to form plasma from the gas mixture, the low frequency power source is providing power (1-10 kW) that includes the claimed range (4.2-5.0 kW).

With respect to claim 18, the process of Van Cleemput further comprises: providing a high frequency (HF) power source operable to bias the substrate, the high frequency power source is providing power (0.5-10 kW) that includes the claimed range (1.0-1.4 kW).

With respect to claims 31-33, as best understood by the examiner, the gap (510) of Van Cleemput is filled at an etch-to-deposition ratio.

***Claim Rejections - 35 USC § 103***

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

5. Claim 13 is rejected under 35 U.S.C. 103(a) as being unpatentable over Van Cleemput '150.

Van Cleemput teaches the gas mixture of Van Cleemput is at pressure below 10 mTorr, thus encompasses the claimed range (3.5-5.5 mTorr). (See col. 3, ll. 55-58).

***Response to Arguments***

6. The Declaration under Rule 1.132 has been considered, however, the Declaration is ineffective because it fails to provide evidence in which BUC may be larger than UBUC. At best, Chen Declaration concludes "Accordingly, under some conditions for low deposition rates and high aspect ratio gaps, the deposition rate with bias (BUC) may be larger than the deposition rate without bias (UBUC) and therefore the E/D ratio, as defined by the Applicant may be negative in some cases".

7. Applicant's arguments with respect to claims 1, 19 and 30 have been considered but are moot in view of the new ground(s) of rejection.

***Conclusion***

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Anh D. Mai whose telephone number is (571) 272-1710. The examiner can normally be reached on 9:00AM-5:00PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Wael Fahmy can be reached on (571) 272-1705. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

A handwritten signature in black ink, appearing to read 'Anh D. Mai', with a stylized flourish extending from the end.

Anh D. Mai  
June 24, 2004